Exhibit C.5
Attachment 8
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Rebuilding Analysis for Darkblotched Rockfish

Addendum #1

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The SSC's review of the initial rebuilding analysis for darkblotched rockfish prepared by Dr. Jean Rogers in June 2001 resulted in two recommendations: the rebuilding analysis should be based on an assessment update that included the 2000 survey data, and recruitments during the more recent era should be the basis for the rebuilding rate. This document provides an update to the rebuilding analysis using only results from the 2001 assessment update. Rebuilding projections are presented based upon two scenarios for estimating the virgin recruitment level and, for each of these scenarios, two scenarios for estimating future recruitment levels. Of these four scenarios, the recommended result is based upon virgin recruitment estimated from the entire time series and future recruitment estimated from the more recent portion of the time series. Analyses utilize the methodology developed by Punt (2001).

The 2000 survey biomass estimate was similar to the 1997 slope survey biomass estimate and lower than the 1999 slope survey biomass estimate. Updating the assessment model with the 2000 data results in a downward revision in the estimated recruitment and abundance throughout the time series (Figures 1-3, Table 1). The major change is in the level of recruitment since the mid-1980s (Table 2). In the original assessment model, the mean level of recruitment was similar in the early (1963-1982) and late (1983-1996) eras of the time series. With the updated model, the mean recruitment in 1983-1996 is only 67% of the earlier level. This decline in recruitment results in the estimated level of spawn output projected to the beginning of 2002 to be only 12-14% of the virgin level, depending upon whether the virgin level is taken from the initial conditions of the assessment or from the mean level of recruitment during 1963-1996.

The updated assessment model has the same basic life history parameters as the original model. With these parameters, F50% is 0.0321; generation time is 33 years; and the unfished level of spawn output per recruit is 18.42.

The initial rebuilding analysis used recruitments from 1984-1994 for the forecast. Here with the addition of 2000 survey data it is reasonable to include recruitments through 1996 since these fish are well represented in the survey. Also, the early year break is moved from 1984 back to 1983 to more clearly delineate the shift from higher to lower recruitment level. Although the updated assessment provides abundance estimates through 2001, the recruitments for the last few years are simply assumed levels. For the rebuilding analysis, the calculations start with the

estimated numbers at age in 1998, generate recruitments with a random pattern beginning in 1999, and use the observed or extrapolated catch level for 1999, 2000, and 2001.

The downward shift in recruitment beginning in the mid 1980s is probably due to an combination of two factors: decreased abundance of spawners and shifts in ocean conditions. It is probable that both have some impact on the decline in recruitment, but the relative magnitude of these two factors cannot be unambiguously determined from available data. In order to examine the potential consequences of these two hypotheses, four rebuilding scenarios were constructed.

A1 - Environment hypothesis: Virgin recruitment determined from the long-term average (1963-1996) which spans good and poor environmental conditions. Recruitments during rebuilding are taken only from the recent (1983-1996) era with poor recruitments in recognition of the uncertain time at which mean recruitment will again shift.

A2 - Virgin recruitment as in A1, but recruitment during rebuilding is taken from the entire time series (1963-1996) in recognition of the possibility that future recruitments will be better represented by the entire historical period. This is an optimistic scenario that is supported only by the moderately strong recruitment in 1995 and 1996.

B1 - Stock-Recruitment hypothesis: Virgin recruitment determined from the model initial conditions in recognition of the historical abundance of the stock. Recruitments during rebuilding are taken from the recent era. This is a pessimistic scenario because it does not account for increased recruitment even as the stock rebuilds.

B2 - Virgin recruitment from initial conditions and rebuilding recruitments from the entire time series.

The results of the rebuilding analyses for the four scenarios is summarized in Table 3 and Figures 4-5. Note that in Scenario A2 and B2, the possible fishing mortality rate during a nearly 50 year rebuilding period would exceed the F50% level. Scenario A1 with a 50% probability of rebuilding in the maximum allowable time frame would have short-term rebuilding OY slightly above the ABC. At a 60% probability of rebuilding, the Scenario A1 OY in 2002 would be 181 mt which is less than the F50% ABC of 187 mt. Restriction of the OY during rebuilding to the ABC level would reduce the short-term OY in scenario A2 to a level near that in scenario A1.

Scenario A1 is considered to be a reasonable basis for forecasting the rebuilding of darkblotched rockfish. It provides for short-term harvest (181 mt in 2002 for a 60% probability of rebuilding) that is similar to status quo and to the F50% ABC level, and is intermediate between scenarios A2 and B1. The 40:10 OY adjustment would reduce the 2002 OY substantially because the projected spawning biomass in 2002 is at 14% of the virgin level.

All four scenarios are based upon the updated assessment model which estimates current stock abundance to be low and implies that the catchability for the shelf and slope trawl surveys is near 1.0. If the actual catchability is less than 1.0, then the current biomass is being underestimated. Improved estimates of catchability and current biomass will be obtained as the survey time series gets longer and as new analyses of survey data are conducted. Meanwhile, the high estimated catchability implies a degree of precaution in these projected levels of catch during rebuilding.

A table of the rebuilding trajectory for scenario A1 is presented in Table 4 and the input parameter file is in the appendix.

Appendix. Input file for rebuilding analysis with Scenario A1

#Title,,
Darkblotched - with 2000; virgin=63-96; resamp=83-96
Number of sexes,,
2,,
Age range to consider (minimum age; maximum age),,
1,40,
First year of projection,,
1998,,
Is the maximum age a plus-group (1=Yes;2=No),,
1,,
Generate future recruitments using historical recruitments (1), historical recruits/spawner (2), or a stock-recruitment (3)
1,,
Constant fishing mortality (1) or constant Catch (2) projections,,
1,,
Pre-specify the year of recovery (or -1) to ignore,,
-1
Fecundity-at-age,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
#
1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40
0,0,0,0.0005,0.0059,0.0386,0.1386,0.3234,0.5741,0.8582,1.1487,1.4279,1.6874,1.9228,2.1336,2.321,2.4857,2.63,2.7557,2.8648,2.9591,3.0406,3.111,3.1712,3.2228,3.2669,3.3047,3.3369,3.3644,3.3878,3.4078,3.4248,3.4393,3.4516,3.462,3.4709,3.4785,3.4849,3.4904,3.5136
Age specific information (Females then males) M; body wt; selex; Numbers,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
Females,,,,,,,,,,,,,,,,,,,,,,,,,,,,
0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05
0.0518,0.1358,0.2632,0.3774,0.4724,0.5598,0.6453,0.729,0.8095,0.8852,0.955,1.0182,1.0746,1.1246,1.1685,1.2068,1.24,1.2687,1.2935,1.3148,1.333,1.3487,1.3621,1.3736,1.3833,1.3917,1.3987,1.4048,1.4099,1.4143,1.418,1.4212,1.4239,1.4261,1.4281,1.4297,1.4311,1.4323,1.4333,1.4375
0.0011,0.0023,0.0176,0.1077,0.323,0.573,0.7587,0.8681,0.9268,0.9578,0.9745,0.9838,0.9892,0.9925,0.9945,0.9959,0.9968,0.9974,0.9978,0.9981,0.9984,0.9986,0.9987,0.9988,0.9989,0.9989,0.999,0.999,0.9991,0.9991,0.9991,0.9992,0.9992,0.9992,0.9992,0.9992,0.9992,0.9992,0.9992,0.9993
1338.4,176.1,790.9,1642.5,260.3,417.4,379.6,201.2,83.3,271.3,214,228.2,92.5,60.2,33.5,30.2,77.2,111.4,115.1,56.4,28.9,19.4,15.8,17.7,55.1,3.5,40.2,0.1,0.5,71.3,3.3,36.2,0.1,0.1,0.1,24.6,9.6,8.4,7.6,119
Male,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05,0.05
0.0435,0.1173,0.227,0.3327,0.4232,0.5018,0.5743,0.6419,0.7021,0.754,0.7983,0.8358,0.8674,0.

8937,0.9155,0.9335,0.9483,0.9604,0.9703,0.9784,0.9851,0.9904,0.9948,0.9983,1.0012,1.0035,1.0054,1.0069,1.0081,1.0091,1.0099,1.0106,1.0111,1.0116,1.0119,1.0122,1.0124,1.0126,1.0128,1.0133

0.001,0.0018,0.0118,0.0758,0.2592,0.5105,0.7156,0.8405,0.9073,0.9422,0.9612,0.9724,0.9794,0.9839,0.987,0.9892,0.9908,0.9919,0.9927,0.9933,0.9938,0.9942,0.9944,0.9947,0.9948,0.995,0.9951,0.9952,0.9952,0.9953,0.9953,0.9954,0.9954,0.9954,0.9955,0.9955,0.9955,0.9955,0.9955,0.9955

1338.4,176.1,791,1644.3,262,424.4,389.4,207.6,86.3,282.2,222.8,238.3,96.9,63.1,35.2,31.8,81,116.6,120,58.6,29.9,20,16.2,18.2,56.4,3.5,41,0.1,0.5,72.7,3.3,36.9,0.1,0.1,0.1,25.5,9.9,8.7,7.8,120.9

Number of simulations,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,

1000,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,

recruitment and biomass,,,,,

Number of historical assessment years ,,,,,

37,,,,,

Historical data,,,,,

year,recruitment,spawner,in B0,in R project,in R/S project

1950,1577,29044,1,0,0

1963,4143,28036,0,0,0

1964,10,27908,0,0,0

1965,10,27858,0,0,0

1966,10,27552,0,0,0

1967,3965,25090,0,0,0

1968,330,21287,0,0,0

1969,6646,19389,0,0,0

1970,45,19053,0,0,0

1971,10,18654,0,0,0

1972,2996,18125,0,0,0

1973,240,17634,0,0,0

1974,3514,17467,0,0,0

1975,1035,17329,0,0,0

1976,838,17489,0,0,0

1977,928,17503,0,0,0

1978,1226,17786,0,0,0

1979,2095,17998,0,0,0

1980,3678,17581,0,0,0

1981,3008,17549,0,0,0

1982,1731,17408,0,0,0

1983,555,16486,0,1,1

1984,499,15888,0,1,1

1985,728,14873,0,1,1

1986,913,13447,0,1,1

1987,1841,12659,0,1,1

1988,1418,10860,0,1,1

1989,1480,9681,0,1,1

1990,375,8802,0,1,1

1991,755,7704,0,1,1

1992,1208,6799,0,1,1
1993,1155,6407,0,1,1
1994,650,5563,0,1,1
1995,3830,5066,0,1,1
1996,1749,4703,0,1,1
1997,370,4346,0,0,0
1998,2677,3910,0,0,0
Number of years with pre-specified catches,,,,,
4
catches for years with pre-specified catches,,,,,
1998,889
1999,326
2000,236
2001,130
Number of future recruitments to override,,
0,,
Process for overiding (-1 for average otherwise index in data list),,
Which probability to product detailed results for (1=0.5; 2=0.6; etc.),,
1,,
Steepness,sigma-R,
0.5,0.5,
Target SPR information: Use (1=Yes), target SPR rate,power
0,0.5,1
Discount rate (for cumulative catch),,
0.1,,
Truncate the series when 0.4B0 is reached (1=Yes),,
0,,
Set F to FMSY once 0.4B0 is reached (1=Yes),,
0,,
Percentage of FMSY which defines Ftarget
0.9
Conduct MacCall transition policy (1=Yes)
0
Defintion of recovery (1=now only;2=now or before)
2
Produce the risk-reward plots (1=Yes)
0